Project No. 18-3-5397

Geotechnical Report for Cochrane Municipal Water and Sewer

Terraspec Engineering Inc.
Geotechnical Engineers
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APPENDICES

terraspec engineering inc.
geotechnical engineers and materials testing

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July 7, 2019

The Greer Galloway Group Inc.
1620 Wallbridge Loyalist Road
Belleville, Ontario
K8N 4Z5

Re: Geotechnical Report for Cochrane Municipal Water and Sewer
Project Number 18-3-5397

General Data
The project is located on Highway 11 south, between Highway 11 west and Menard Lake Road, in the Town of Cochrane, Ontario. It is anticipated that new water main will be installed, and that new sewer main will be installed to depths of up to 5m below finished grade. In the case that a pumping station is required, it is anticipated that it will be placed in the northeast quadrant at Highway 11 and Menard Lake Road. The total length of the project is 1.7km.

The soil physiography for this location is identified as clay plains. The subsoils in this area typically consist of relatively deep depths of clay overlying granitic bedrock.
There is often an organic peat layer overlying the natural clay.

Investigation
Site investigation was conducted on June 25, 2019. Fifteen exploratory boreholes were placed along the proposed alignment of the new water and sewer mains. Boreholes were placed with 130mm diameter solid stem augers, to typical depths of 5.18m to 7.77m. Soil laboratory testing consisted of moisture content determination, hydrometer grain size analysis, and Atterberg Limits determination. The borehole log data and laboratory test data has been appended to this report. The borehole locations have been shown on a site drawing appended to this report.

Soils Data
The typical soil layers encountered were as follows:

Soil Type	Comments
clayey topsoil	organic
crushed gravel & sand	fill material
medium sand trace gravel	fill material

silty sand with gravel/cobble	fill material
amorphous peat	organic
clay sand	disturbed clay
clay some organics	disturbed clay
clay	natural clay
silty clay	natural clay

The peat layer was variable throughout the project, but the average thickness of this layer was large, at 1.7m. The texture of the peat was somewhat variable and ranged from fibrous to amorphous.
The condition of the peat was typically wet and very loose.

Some various fill soils and disturbed clay soils were encountered near to the ground surface. These soils were typically in a moist to wet condition, but relatively compact.

The condition of the natural clay varied from firm to stiff. The moisture content of the clay ranged from 30 to 35 %. The clay typically had intermediate plasticity.

Perched groundwater seepage was common at most of the boreholes, with water seepage frequently encountered at 1.5 to 1.8m below existing ground surface.

Recommendations

Excavation and Dewatering
It is anticipated that a continuous dewatering operation will be required to conduct excavations in this area. The OHSA soil types for excavation are listed in the borehole logs. It is anticipated that all soils below the groundwater seepage elevation are a minimum Type 3 soil, and may also require treatment as Type 4 collapsing soils.

Use of temporary sheet piling to hold back the Type 4 subsoils and to assist with groundwater removal, may be required to allow excavation without disturbing the existing natural gas main, and to install the pumping station.

Placement of test pits during the contract tendering process to allow interested bidders to observe the existing soil and groundwater conditions would be advisable for this project. Use a test pit depth of 5m. Some of the poorer soil conditions that should be observed were encountered at borehole locations 30, 28, and 3. A test pit at the pumping station location would also be advisable.

A permit to take water or an equivalent EASR should be obtained prior to the start of construction.

Re-Use of Subsoils

Fill Soils

The various fill soils as described above may be re-used as subgrade fill on the approval of the construction CA. Much of these soils were wet and will require drying prior to use.

Natural Clay Soils

The natural clay subsoils will be very difficult to place and achieve compaction if it is either too wet or too dry. The CA contract will need to have frequent construction testing done on the clay subsoils to determine Standard Proctor values and optimum water content, for the subsoils that will be re-used as compacted backfill. It is anticipated that the moisture content of the subsoils will be required to be within +/- 3% of optimum moisture content, as determined by Standard Proctor determination (ASTM D698).

Organic Soils

Since the peat will only be useful as surface dressing, it is expected that additional subgrade fill will be required to backfill the trenches up to original surface grade. It is suggested that additional fill meet the requirements of OPSS 1010 Select Subgrade Material (SSM). This material can be a sand or silty sand; the main requirement is that the material will be non-plastic. As such, this material will be preferable for surface backfill where there are commercial entrances and/or driveways which will cross over the trench excavations. Allow for an SSM contingency in the contract. The estimated quantity is 1193m3. A unit price for this item in the contract would be useful in case there is variation in the quantity.

Pipe Installation

Use OPSD 800 series standard drawings for new sewers, typically OPSD 802.010 for flexible pipe, or OPSD 802.031 for rigid pipe, with a Class B bedding. The bedding, cover, and backfill materials will need to be comprised of gravel for placement in wet subgrade conditions. It is anticipated that OPSS 1010 Granular B Type 2, with a maximum particle size of 50mm, will be required. Use a pipe bedding thickness of 300mm, and allow for a granular pipe cover thickness of 300mm.

Place a woven geotextile cloth over the pipe cover, to prevent the upper trench backfill materials from sinking into the underlying Granular B2 material.

Use OPSD 803.030 and OPSD 803.031 where granular frost tapers are required. The frost penetration treatment depth for this location is 2.4m below finished grade.

It has been assumed that a pumping station will be situated at an approximate depth of 15.24m at borehole 16. Place a Granular B2 bedding layer on the undisturbed clay subsoil at the footing level.

Utilize an allowable soil bearing capacity of 162 kPa.

Pavement Reinstatement
Construct earth grading of the road subgrade as per OPSD 200.01.
Reinstate pavement structure as follows:

40mm	HL3 HS Surface Course
50mm	HL8 Binder Course
150mm	Granular A base
450mm	Granular B1 subbase
910mm	SSM

{over compact subgrade or approved fill}

The purpose of the SSM fill layer is for pavement strength and frost protection.
Materials for hot mix pavement should be as per OPSS 1150 specifications.
The asphalt cement should have a minimum rating of PGAC 52 -40. A cement with a better cold temperature rating will also be acceptable. Stipulate in the contract that all hot mix paving operations shall be carried out in strict accordance with OPSS 310 specifications.

Compaction Requirements
Compaction requirements for all SSM fill and granular materials should conform with OPSS 501, Subsection 501.08.02 - Method A, utilizing a compaction standard of 100% of Standard Proctor Maximum Dry Density. For the natural clay subsoils re-used as subgrade fill, a compaction standard of 98% of Standard Proctor Maximum Dry Density may be utilized.

Summary Comments
Excavate some observation test pits during the contract tendering process.
Allow for an SSM contingency in the contract.
Due to the subgrade conditions (peat, wet soils, perched groundwater), plan for construction to occur in the summer months (June, July, August), if possible.

Statement of Limitations
This report is intended for the guidance of the project design team. From a construction standpoint, contractors must make their own assessment of the soil, rock, and groundwater conditions and how these will affect their proposed construction techniques and schedules.

The recommendations in this report are based on information determined at the test hole locations. Soils and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations and conditions may become apparent during construction that could not be detected or anticipated at the time of the soils investigation. If this occurs, we recommend that Terraspec be recalled to the site for further consultation, testing, and analysis.

We also recommend that Terraspec be consulted to ensure that all subgrade preparation requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in test holes. In cases where any of our recommendations are not followed, the

company's responsibility is limited to interpreting the information from the test hole data at the test hole locations.

Elevations quoted in the document are approximate. Original ground elevations for project design purposes should be obtained from an experienced topographical survey consultant. This report is applicable only to this specific project, constructed substantially in accordance with details of alignment and elevations quoted in the text.

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TERRASPEC ENGINEERING INC.
GEOTECHNICAL ENGINEERS

Shane Galloway, B.A.
Manager

N.A. MacKinnon, P.Eng.
Senior Engineer

Borehole Data
Highway 11
June 25, 2019

Notes

1. Soil types, strata, and groundwater conditions have been established only at test hole locations.
2. Soils are described according to the MTO Soils Classification System and OPSD 100.06.
3. Dimensions are in millimetres up to 1 metre, then in metres thereafter.

Abbreviations

amor	-	amorphous			
asph	-	asphalt	&	-	and
blds	-	boulders	w	-	with
blk	-	black	so	-	some
br	-	brown	tr	-	trace
BR	-	bedrock			
cl	-	clay(ey)	S	-	soil sample
cob	-	cobbles	Su	-	vane shear strength (kPa)
conc	-	concrete			
cr	-	crushed			
f	-	fine			
gr	-	gravel(ly)			
gry	-	grey			
med	-	medium			
NFP	-	no further progress			
org	-	organics			
RF	-	rock fill			
sa	-	sand(y)			
si	-	silt(y)			
tps	-	topsoil			

32

0	-	600	br med sa tr gr -wet, compact	Type 4
600	-	2.45	br amor peat -wet, very loose	Type 4
2.45	-	5.18	gry cl -moist, firm to stiff	Type 3

at 4m Su = 50kPa
-stiff at 4.88m
-water seepage at 2.45m

30 **********

0	-	1.70	br med sa tr gr -moist, loose		Type 4
1.70	-	5.18	gry cl -wet, firm	S3 at 4.9m	Type 3

-stiff at 4.88m
-water at 1.37m

1

0	-	1.24	br si sa w gr/cob Fill -moist, compact	Type 3
1.24	-	1.85	br amor peat -wet, very loose	Type 4
1.85	-	5.18	gry/br cl -moist, firm	Type 3

-stiff at 3.6m
-water seepage at 3.55m

29

0	-	910	cr gr & sa Fill -dry, compact	Type 3
910	-	3.35	br amor peat -moist, very loose	Type 4
3.35	-	4.87	gry cl -wet, firm to stiff	Type 3
4.87	-	6.4	gry cl -wet, stiff	Type 3

at 5m Su = 90kPa
-water seepage at 1.52m

28 datum -0.9m **********

0	-	2.74	br amor peat -saturated, very loose	Type 4
2.74	-	7.77	gry cl -wet, firm	Type 4

-stiff at 7.6m
-water at 1.22m

3 datum -0.61m **********

0	-	1.75	br amor peat -moist, very loose	Type 4
1.75	-	3.11	br cl w org -moist, loose	Type 4
3.11	-	5.18	gry cl -wet, firm	Type 3

at 4m Su = 40kPa
-water seepage at 1.75m

26

0	-	1.98	br med sa tr gr -wet, compact	Type 4
1.98	-	2.74	br cl sa -wet, loose to compact	Type 3
2.74	-	5.18	gry cl -moist to wet, stiff	Type 3

-water at 1.52m

24 datum -1.2m

0	-	150	br cl tps	
150	-	1.60	br cl -moist, very stiff S2 at 1.5m	Type 2
1.60	-	5.18	gry cl -moist, stiff	Type 2

-trace water seepage at 3.04m

7

0	-	300	br med sa tr gr -moist, compact	Type 3
300	-	1.23	gry/br cl so org -moist, firm	Type 3
1.23	-	5.18	br cl -moist, very stiff	Type 3

-stiff at 4.6m
-trace water seepage at 1.45m

9 datum -1m

0	-	300	br med sa tr gr -moist, loose	Type 4
300	-	1.60	br amor peat -moist, very loose	Type 4
1.60	-	5.18	gry cl -moist, firm to stiff	Type 3

-stiff at 3.0m
at 3m Su = 80kPa
-trace water seepage at 5.0m

20

0	-	2.20	br amor peat -moist, very loose	Type 4
2.20	-	3.66	gry cl -wet, firm	Type 4
3.66	-	6.1	gry cl -moist, stiff	Type 3

at 4.6m Su = 90kPa
-water at 1.83m

11

0	-	600	br med sa tr gr -moist, compact	Type 3
600	-	1.48	br amor peat -moist, very loose	Type 4
1.48	-	5.18	gry cl -moist, stiff	Type 3

at 2m Su = 90kPa
-firm after 3m
at 4m Su = 50kPa
-trace water seepage at 3.0m

18

0	-	1.60	blk amor peat -moist, very loose	Type 4
1.60	-	5.18	gry cl -moist, firm to stiff	Type 3

-water at 1.83m

14

0	-	80	br cl tps		
80	-	400	gry cl -moist, firm		Type 3
400	-	1.95	br amor peat -moist, very loose		Type 4
1.95	-	5.18	gry cl -moist, firm to stiff		Type 3

-stiff after 2.4m
-firm after 3.35m
at 3.4m Su = 50kPa
-stiff after 4.26m
-trace water seepage at 4.87m

16

0	-	1.51	blk amor peat -moist, very loose		Type 4
1.51	-	6.10	gry cl -wet, firm		Type 3
6.10	-	15.39	gry si cl -wet, stiff	S1 at 15.2m	Type 3/Type4

at 15m Su = 100kPa
-water at 2.13m
-there is potential Type 4 soil collapse due to wet the soils and deep excavation

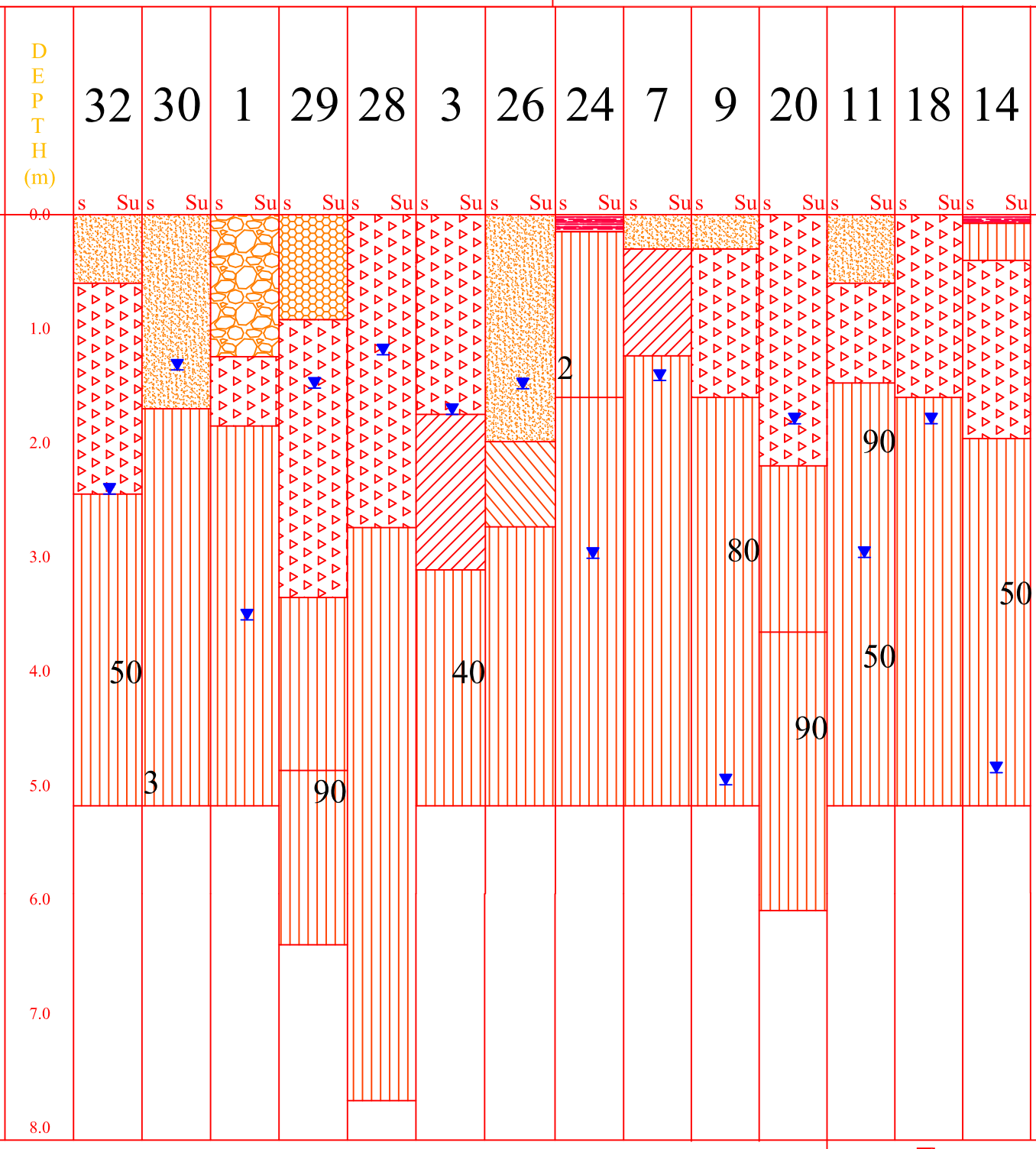
Laboratory Test Data

Soil Sample	**1**	**2**	**3**	
Sieve	**% Passing**			
4.75mm	100	100	100	grain size
2.00mm	99.9	100	99.9	
850um	99.7	99.8	96.3	
425um	99.5	99.6	88.3	
250um	99.3	99.1	82.0	
106um	99.0	98.5	76.9	
75um	98.8	98.4	76.3	
% gravel	0	0	0	gravel
% sand	1.2	1.6	23.7	sand
% silt	44.5	9.0	6.8	silt
% clay	54.4	89.4	69.5	clay
ASTM	CL	CI	CI	soil classification
frost rating	Mod	Low	Low	susceptibility to frost heave
LL	25.5	43.1	35.7	liquid limit
PL	16.1	21.3	18.5	plastic limit
PI	9.4	21.8	17.2	plastic index
W	35.8	30.5	30.3	field moisture content

BOREHOLE LOG DATA

PROJECT No.: 18-3-5397
CLIENT: Town of Cochrane
PROJECT: Highway 11
DATE: June 25, 2019

SOIL DATA
METHOD: 130mm Solid Stem Auger
s = sample
Su = shear strength (kPa)
▼ encountered water elevation

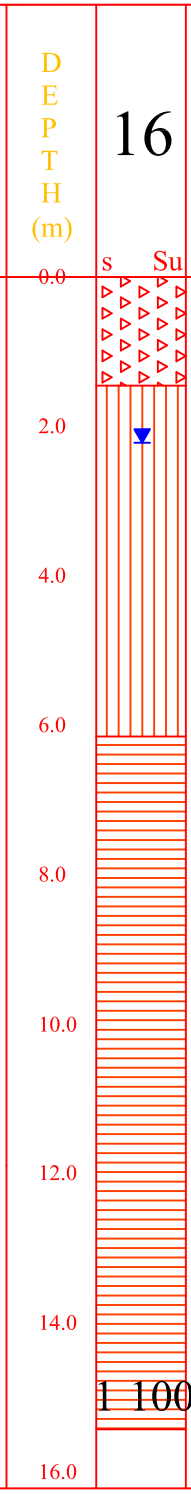


Terraspec

BOREHOLE LOG DATA

PROJECT No.: 18-3-5397
CLIENT: Town of Cochrane
PROJECT: Highway 11
DATE: June 25, 2019

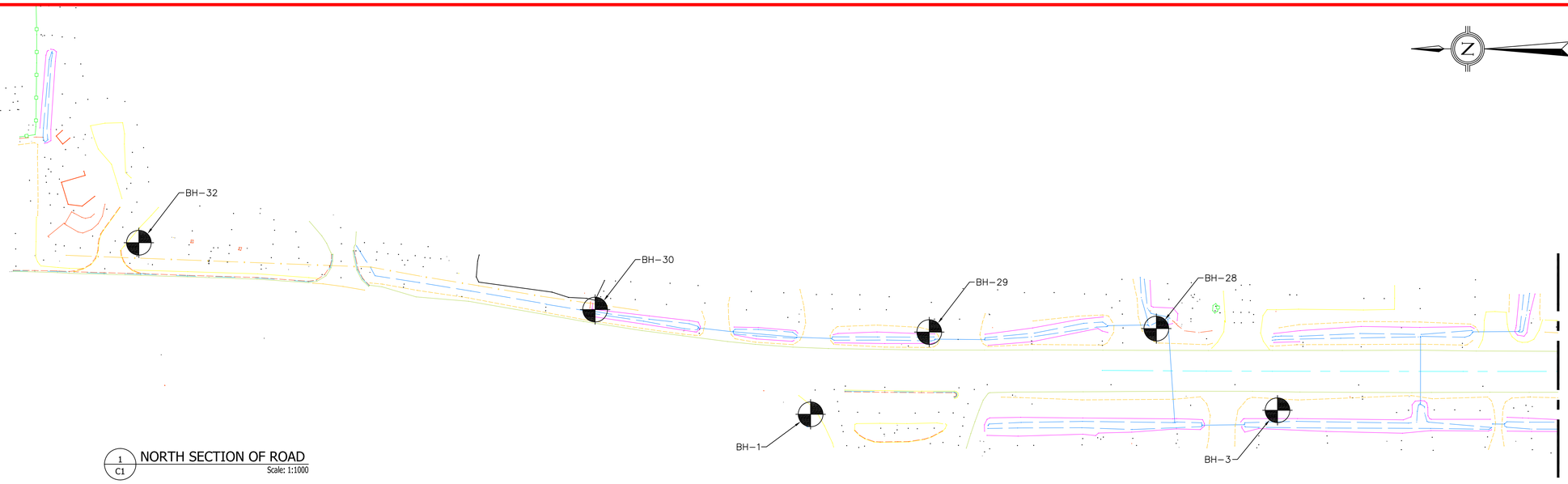
SOIL DATA
METHOD: 130mm Solid Stem Auger
s = sample
Su = shear strength (kPa)
▼ encountered water elevation



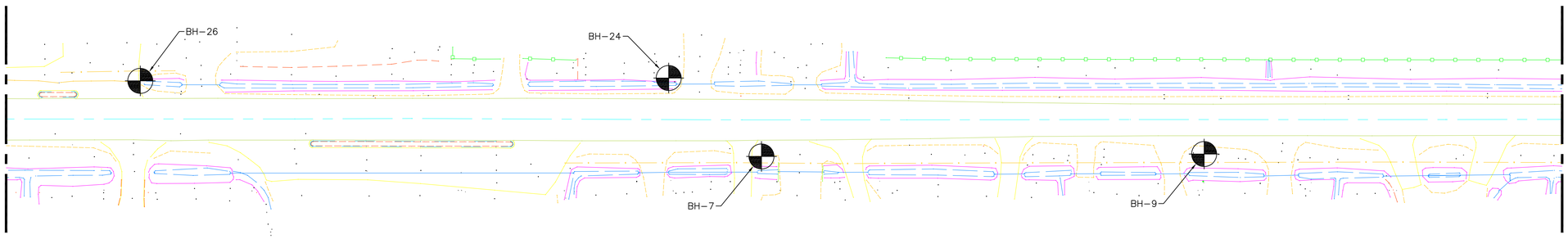
LEGEND

- clayey topsoil
- crushed gravel & sand
- medium sand trace gravel
- silty sand with gravel/cobble
- amorphous peat
- clay sand
- clay some organics
- clay
- silty clay

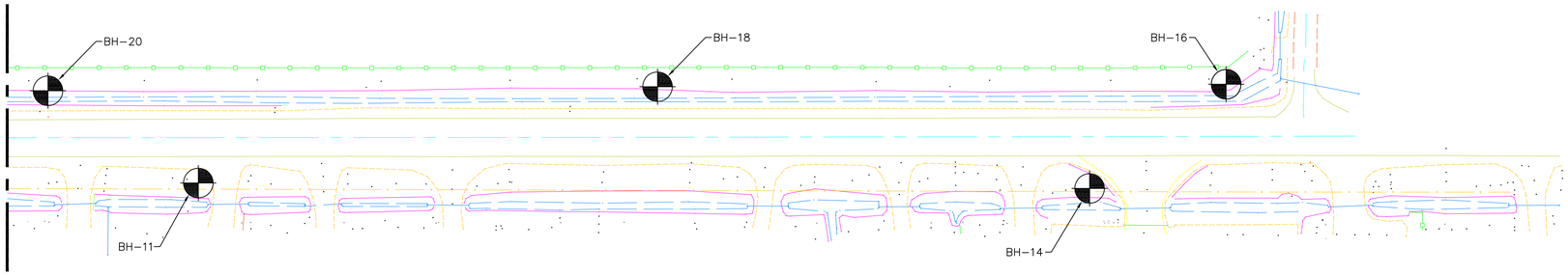
Terraspec



1 / C1 NORTH SECTION OF ROAD
Scale: 1:1000



2 / C1 CENTRE SECTION OF ROAD
Scale: 1:1000



3 / C1 SOUTH SECTION OF ROAD
Scale: 1:1000

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NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH RELEVANT CODES AND GUIDELINES.

2. ALL DRAWINGS AND ADDENDA ARE TO BE READ AS, AND IN CONJUNCTION WITH THE SPECIFICATIONS.

3. ALL EQUIPMENT SHALL BE INSTALLED AS SPECIFIED OR APPROVED EQUIVALENT.

4. CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS BEFORE PROCEEDING WITH WORK AND BE RESPONSIBLE FOR SAME.

5. CONTRACTOR MUST REPORT ANY DISCREPANCIES TO ENGINEER FOR RESOLUTION BEFORE COMMENCING THE WORK.

6. ANY CHANGES MUST BE APPROVED BY THE ENGINEER.

A / B A DETAIL NO.
B DRAWING NO. – WHERE DETAILED

LEGEND

NORTH

STAMP

PROJECT
HIGHWAY 11
ROAD REHABILITATION

COCHRANE, ONTARIO

DRAWING TITLE
BOREHOLE LOCATION SKETCH

REVISION		DATE
05		
04		
03		
02		
01	ISSUED FOR REVIEW	

DESIGNED BY

DRAWN BY

REVIEWED BY

APPROVED BY

PROJECT DATE
05/06/2019
(DD/MM/YYYY)

PROJECT # 18-3-5397

SCALE
HOR: AS NOTED
VER: AS NOTED

DRAWING # C1

CAD OPERATOR: Jordan
CAD FILE: C:\temp\Cochrone Hwy 11\Acad Bh Sketch.dwg
PLOT SCALE: AS NOTED
DATE PLOTTED: DD/MM/YYYY
GGC-A1

(METRIC SCALE – ALL DIMS IN MILLIMETERS)